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Factors Affecting Annualized Milk Yield in Friesian Cows in Egypt

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THE FIXED effects of farm, season and year of calving, parity and interactions of farm by season of calving, farm by parity and season of calving by parity on annualized milk yield (AMY) were studied on 1619 records of Friesian cows in their second and later lactations. A least squares analysis of variance showed significant effect ($p<.01$) of all factors. Interactions effects were not signifiant.

Including the linear and quadratic regressions of days open (DO) and preceding dry period (DP) resulted in a reduction of 23% of the residual mean squares and yielded a significant effect of linear and quadratic coefficients ($-6.2 \pm .67$ kg / day, $.0052 \pm 0.00133$ kg / day^2, respectively) of AMY on DO. The linear regression of AMY on DP was significant ($-1.74 \pm .956$ kg / day) while the quadratic term ($.00076 \pm .00231$ kg / day^2) was not significant.

Maximum production in the current lactation, including the calf crop expressed in kilograms of milk was attained when cows were bred as early as possible after parturition.

Keywords : Friesian cows, milk yield, factors affecting.

While many investigators have estimated the relationships between 305 - day and total milk yield with days open (e.g. Smith and Legates, 1962; Schaeffer and Henderson, 1972; Khattab and Ashmawy, 1988), there is little work on the effect of days open (DO) on milk yield per unit of time. Louca and Legates (1968) reported that milk yield per day or per year, such as annualized milk yield (AMY), is taken as the measure of economic performance. Thompson *et al.* (1982) using days - open adjusted, annualized, and fat - corrected yields as alternatives to mature equivalent records found small changes in culling decisions and sire evaluation when using AMY or yield adjusted for DO. However, they suggested that more study is needed before AMY can be recommended for cow selection or sire evaluation.

AMY is based on calving interval (CI) and total milk yield (TMY). Hardy *et al.*, (1977) indicated that length of DO was 6 to 10 times more important than gestation length in determining the length of CI.

The present study was undertaken to determine the effect of farm, season and year of calving, parity and preceding dry period (DP) besides Do effect on AMY in Friesian cows in Egypt. In addition, Losses by suboptimal AMY were assessed.

Material and Methods

A total of 1619 records of second and later lactation Friesian cows calving between 1969 in two farms, Sakha and El - Karada, belonging to the Ministry of Agriculture were used. The records of the first lactation were not available for the present study.

Animals were mainly grazed on Egyptian clover, berseem (*Trifolium alexandrinum*) during October-May. They were fed on concentrate mixture along with wheat or rice straw and limited amount of clover hay when available during the rest of the year. Cows producing more than 10 kg a day and those that were pregnant in the last two months of pregnancy were supplemented with extra concentrate ration. Cows were attempted for insemination, as a general rule, 60 - 70 days post partum.

Cows were hand - milked twice a day till 1971 and machine-milked thereafter.

Lactations following abortion or in which milking was interrupted by injury or sickness were excluded from the study.

The length of Do was computed as the interval between the date of parturition and the date of successful mating or by subtracting the mean of gestation period, 275 days (Khattab and Ashmawy, 1988), from the actual CI if the date of successful mating was not known. Length of DP was computed as the interval between the date of drying off and the date of the next calving.

Annualized milk yield (AMY) was computed by the following equation as described by Bar - Anan and Soller (1979) :

AMY = (total lactation milk yield / calving interval) x 365.

The four seasons of calving were winter (December - February), spring (March - May), summer (June - August), and autumn (September - November).

The following fixed model was used to study the effects of farm (f), season of calving (s), year of calving (y), parity (p), and interactions of farm by season of calving, farm by parity, and season of calving by parity using least squares procedures. Also, the model included polynomial regression coefficients of the second degree to describe the relationship between AMY and both DO and DP.

$$Y_{ijklm} = a + f_i + s_j + y_k + p_l + (fs)_{ij} + (fp)_{il} + (sp)_{jl} + \Sigma_i b_r X_{rijklm} + e_{ijklm} \quad (i)$$

Where

yijklm = an AMY of the ijklm *th* observation,

a = a constant term common to all observation,

b_r = the r*th* partial regression coefficient of y_{ijklm} on the X_{rijklm} corrected for farm, season and year of calving and parity effects, r = 1, 2, 3, 4,

X_r = the rth independent variable, where

X1 = days open,

X2 = days open squared,

X3 = preceding dry period, in days,

X4 = preceding dry period squared,

e_{ijklm} = a random element of variance peculiar to each observation included cow effect, with mean zero and variance σ^2.

To calculate the expected loss in AMY due to delayed breeding the following equation was constructed :

$Y = a + b_1x_1 + b_2x_2$,

then the expected loss in AMY at a certain length of DO (ELAMY) is computed by the following equation :

$$ELAMY = (Y_{max} - Y_t) \times .55 \quad (ii)$$

Where

Ymax = expected maximum AMY

Y_t = expected AMY at a certain length of DO, t,

.55 = a constant of income from milk over feed cost per kg. (Willer *et al.*, 1985; and H. Khattab, 1987, personal communication).

The expected loss in calf crop per year due to delayed breeding (ELC) is calculated as following :

Annualized calf crop = (calf value / actual CI) x 365 then, ELC = $ACC_{min} - ACC_t$ (iii)

Where

ACC_t = annualized calf crop at a certain length of DO,

ACC_{min} = annualized calf crop at the minimum length of DO,

Therefore, loss in AMY including the contribution of calf expressed in kilograms of milk was (ii) + (iii) assuming that a calf is equivalent to 270 kg of milk (the average weight of a calf at birth was 30 kg as reported by Omar (1984) using the data of the same herd and considering the 1 kg calf = 9 kg milk using the whole sale price of each).

Results and Discussion

The least - squares mean of AMY was found to be 2944±36 kg (Table 1). However, the estimates of means of 305-day and total milk yield were 3045±27, and 3423±46 kg, respectively (Khattab and Ashmawy, 1988) using the same set of data. The differences between AMY and the other measures of production are due to delayed breeding.

The present results (Table 1) show that there was significant difference (P<.01) in AMY between Sakha farm and El - Karada. The clear difference between the two farms may be due to differences in heat detection, and breeding practices.

Spring calvers had the highest AMY and significantly differed from the other three seasons. It seems that nutritional practices might be responsible for such differences, e.g. difference in dry matter content between early and late cuts of Egyptian clover (Eltawil *et al.*, 1976).

The effect of year of calving on AMY was significant (P<.01). However, no clear trend was noticed.

The parity effect on AMY was significant (P<.01, Table 1). Results indicate that AMY increased with the increase in the order of lactation.

The interactions of farm by season of calving, farm by parity, and season of calving by parity were non significant.

Estimates of partial linear and quadratic regression coefficients of AMY on DO were -6.2 ± .67 kg / day and .0052± .00133 kg / day2, respectively, being significant at P<0.01 (Table 1). Weller *et al.* (1985) found that length of DO affected AMY. It is noticed that maximum production was attained when cows had the shortest DO over the range of 40 to 400 days open (Table 2). Hansen *et al.* (1983) found that AMY was negatively correlated with DO. AMY showed a trend opposite to that shown by 305 - day and total milk yield for the same set of data (Khattab and Ashmawy, 1988). Thompson *et al.* (1982) found that 305 - day mature equivalent yields increased with increased days open while AMY decreased. Louca and Legates (1968) fitting a polynomial of second degree of milk yield on DO, found that there was a decline of 3.6 and 3.7 kg of milk for second and third lactations, respectively, for each additional day open. However, the losses per day open reported herein are smaller than those reported by olds *et al.* (1979). They found that , within herds, each day open between 40 and 140 days of lactation resulted in an average of 8.6 kg less AMY during current lactation for cows in second and later lactations.

TABLE 1. Least squares estimates of effects and standard errors (S.E.) of different factors affecting annualized milk yield of Friesian cows[a].

Classification	No.	Estimate, kg	S.E., kg
Overall mean	1619	2944	36
Farm		**b	
Sakha	1246	+112	30
El - Karada	373	-112	47
Parity		**	
2	660	-178	43
3	495	28	44
4	293	56	50
5	171	94	66
Season of calving		**	
Winter	430	-22	48
Spring	489	139	45
Summer	385	-39	50
Autumn	315	-78	49
Year of calving		**	
1969	78	-269	98
1970	99	-245	85
1971	171	-215	67
1972	262	-306	55
1973	220	-192	58
1974	180	107	64
1975	174	138	66
1976	166	90	69
1977	132	309	73
1978	84	349	90
1979	53	233	115
Regression coefficient			
on days open (kg / day)		-6.22**	.673
on days open squared (kg / day2)		.0052**	.00133
on preceding dry period (kg / day)		-1.74*	.956
on preceding dry period squared squared (kg / day^2)		.0076**	.00231

[a]The interactions of farm by parity, farm by season of calving, and parity by season of calving were not significant.

[b]Indicating the statistical significant of the classification as a source of variation, * P<0.05, ** P<0.01.

TABLE 2 . Loss per year in annualized milk yield plus the contribution of calf crop expressed in kilograms of milk (LAMYICC).

t	Days open (Do)[a]	(1) Expected annualized milk yield (AMY)	(2) E. loss in AMY[b] (ELAMY)	(3) Annualized calf crop (ACC)	(4) Expected loss in ACC (ELC)	(5) LAMYICC = (2) + (4)
1	40	3713	-	313	-	-
2	50	3656	31	303	10	41
3	60	3599	63	294	19	82
4	70	3544	93	286	27	120
5	80	3490	123	278	35	158
6	90	3436	152	270	43	195
7	100	3384	181	263	50	231
8	110	3333	209	256	57	266
9	120	3283	237	249	64	301
10	130	3233	264	243	70	334
11	140	3185	290	237	76	366
12	150	3138	316	232	81	397
13	180	3003	391	217	96	487
14	210	2877	460	203	110	570
15	240	2762	523	191	122	645
16	270	2655	582	181	132	714
17	300	2558	635	171	142	777
18	360	2391	727	155	156	885

[a]Calving interval = Do + 275.

[b]ELAMY = (Ymax - Yt) x .55 since .45 of milk price is spent for feed cost.

The negative relationship observed between DO and AMY may also be due to that longer DO resulted in more days in milk which extend the late lactation part with lower daily production, and in more days dry. Another reason is that DO is a component of the denominator of AMY. Olds *et al.* (1979) found that with peak production occurring during the first few months of lactation, any prolongation of CI was likely to lower average production per unit of time. They also indicated that DO affected lactation period, dry period and persistency.

In contrast, Bar - Anan and Soller (1979) reported that the effects of increasing DO on AMY were generally small and negative.

Loss in milk per year, Assuming that 45% of the price of milk is spent for feed, and loss in calf crop expressed in kilograms of milk are presented in Table 2. AMY plus the contribution of the calf crop was greatest at 40 days open. The number of calves available for replacement also decreased as a result of delayed breeding. Therefore, a length of

DO of 40 days is and appropriate period for maximum production in current lactation for cows in their second and later lactations. Bar - Anan and Soller (1979) found that 30 to 50 DO for cows resulted in the highest annual production over current and following lactations. However, Weller *et al.* (1985) reported that cumulative yield of current and following annualized production including the contribution of calf crops was greatest at 98 DO for multiparous cows and that conception prior two months postpartum had an adverse effect on cumulative production. The difference between the present finding and that of Weller *et al.* (1985) may be due to that cows in their study were high producers. Holmann *et al.* (1984) estimated DO by budgeting simulation of a commercial herd situation for Holstein cows of alternative milk yields with varying calving intervals of 12, 13 and 15 mo. They found that effects were little on annual income over feed cost in the short run for modest increases or decreases of CI.

The partial linear regression coefficient of AMY on DP (-1.74±.956 kg / day) was significant (P<.10). Conversely, the quadratic term (.00076±.00231 kg / day2) was not significantly different from zero (Table 1). Thus, if the non - significant quadratic term was deleted from the prediction equation, the estimates of linear regression coefficient was -.93±.448 kg / day and maximum production was practically attained when cows had the least length of dry period. Dias and Allaire (1982) found that cows with calving intervals less than 340 days required at least 55 days dry for maximizing milk production in two consecutive lactation. However, increasing the length of DP are dependent on the cost of milking cows with extended lactation. Dairy breeders tend to milk their cows in late lactation as long as the difference of income over feed cost per day exceeds the cost of milking.

Including the linear and quadratic regressions for both DO and DP in the model resulted in a reduction of 23% in the residual mean squares.

It appeared from the present study, that maximum production in the current lactation including calf crop was attained when cows were bred as early as possible after parturition. An intensive program of heat detection and efficient practices of insemination would significantly shorten DO as indicated by Slama *et al.* (1976) in their study of factors affecting calving intervals in dairy herd.

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العوامل المؤثرة على كمية اللبن السنوية فى ابقار الفريزيان فى مصر

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درس تاثير المزرعة وفصل وسنة الوضع وترتيب موسم الحليب والتداخل بين المزرعة وفصل الوضع وبين المزرعة وترتيب موسم الحليب وبين فصل الوضع وترتيب موسم الحليب على ١٦١٩ سجل لابقار الفريزيان فى موسم الحليب الثانى والمواسم التاليه له. كانت جميع هذه التاثيرات معنوية فيما عدا تاثير التداخلات وذلك باستخدام طريقة الحد الأدنى للمربعات المعنوية لتحليل التباين .

وعند احتواء النموذج الرياضى على معاملات الاعتماد من الدرجة الأولى والثانية لكل من الفترة من الولادة وحتى التلقيحة المخصبة وكذلك فترة الجفاف السابقة فان ذلك أدى إلى تخفيض متوسط مربعات الخطأ ب ٢٣٪. وكان معاملا الاعتماد من الدرجة الاولى والثانية لكمية اللبن على الفترة من الولادة حتى التلقيحة المخصبة معنويا (-٢.٦ + ٦٧. . كجم / يوم ، ٥٢. . . . ، + ١٣٣. . . . كجم / يوم مربعا – على الترتيب). وكان معامل الاعتماد الخطى لكمية اللبن السنوية على طول فترة الجفاف السابقة معنويا (-٧٤و١ – ٩٥٦و٠ كجم / يوم) بينما معامل الاعتماد من الدرجة الثانية (٧٦٠٠٠و٠ – ٢٣١٠٠و٠ كجم / يوم٢) غير معنوى.

بينت الدراسة الحالية أن أقصى إنتاج للبن فى الموسم مشتملا على المحصول الناتج من العجل معبرا عنه بالكيلوجرامات من اللبن نصل إليه عندما تلقح الأبقار مبكرا كلما أمكن بعد الوضع.